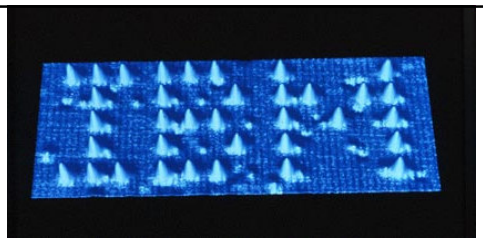
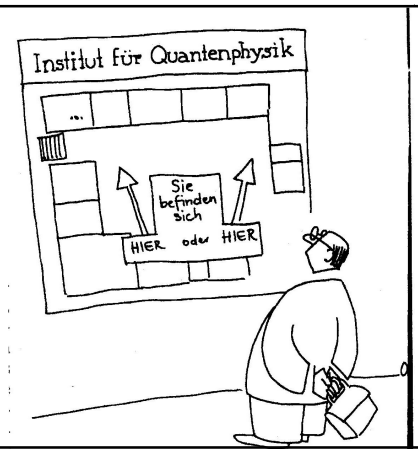


Wednesday, October 10

Ford: Chs 1-3

YouTube



Agenda

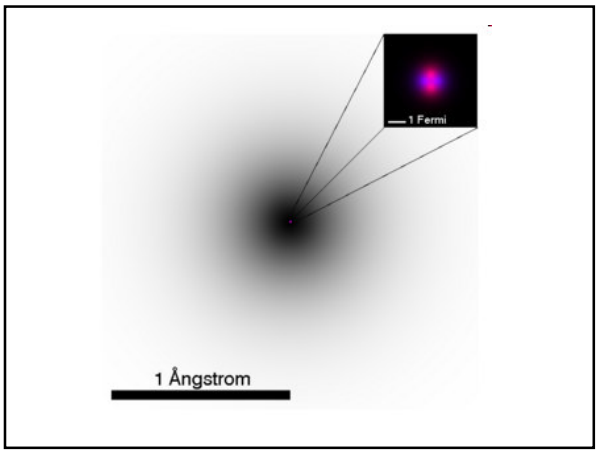
- Announce:
  - More Project Ideas:
    - Quantum Computers
    - Quantum Imaging
    - Photonics
  - Read Chs. 4 & 5 for next time
  - Pass back and discuss tests
- Ch. 1
- Ch. 2
- Ch. 3

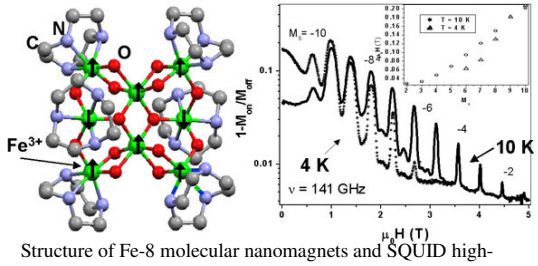
Ch. 1

- Atoms mostly empty space (e.g. propeller)
- Atoms very big compared to subatomic world
- Existence of atoms still in doubt in early 1900s
- Some particles: electron, proton, photon
- Standard Model: quarks, Higgs, leptons, force carriers
- Classical determinism vs quantum probabilities

Ch. 2—Small/Fast

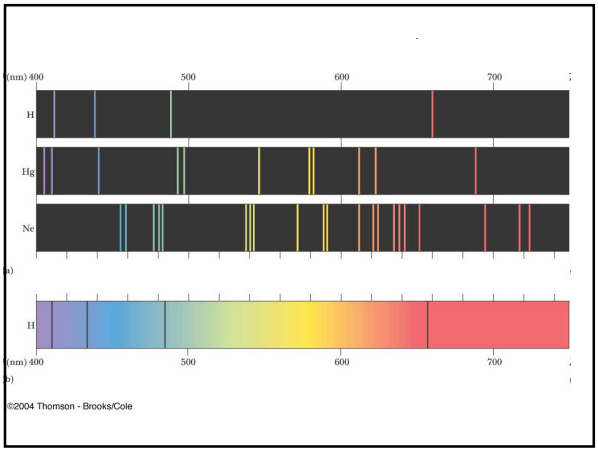
- Scientific Notation (of necessity)
- Range of units (eV, angstroms, etc)
- Physical Constants (h, hbar, c)
- What does it mean to be quantized?
- Charge:
  - Fundamental (property & force)
  - We're not sure why it's quantized
  - Holds electrons in atom
  - Balances strong force (gluons) inside nucleus
- Spin
  - A measure of angular momentum (different than orbital)
  - Fundamental property of particles (half-integer, and integer)
  - quantized

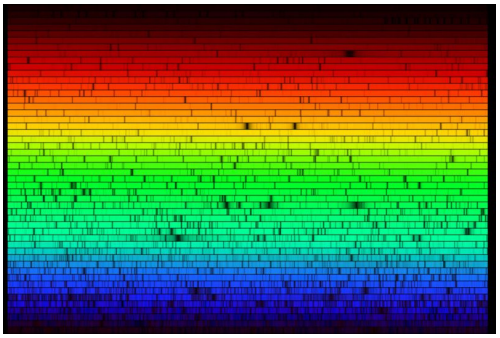


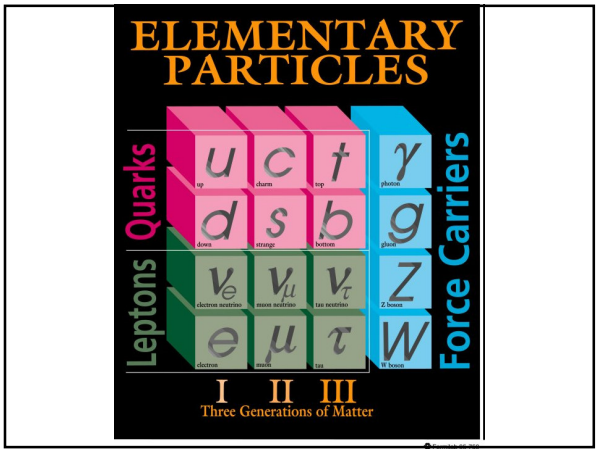


Structure of Fe-8 molecular nanomagnets and SQUID high-frequency EPR spectra of Fe-8 showing resonant absorption corresponding to transitions between the quantized energy levels.

From:
http://www.boulder.nist.gov/div818/81803/2005/MagneticThinFilms/index.html







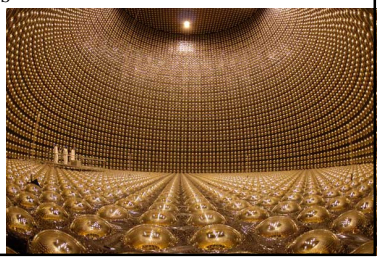
Ch. 3—The Leptons

- Antiparticles/antimatter—particles identical to their partners except the opposite charge (same mass and spin)
- Electron (1897 JJ Thompson)
  - First fundamental particle discovered
  - Basis of all electronics (but for how much longer?)
  - Negative charge, 1/2000 mass of proton
- Radioactivity
  - Probabilistic radiation/decay
  - Alpha particles—helium nucleus
  - Beta particles—electron (and anti neutrino
  - Gamma –high energy photon

Α α	alpha	Ν ν	nu
Β β	beta	Ξ ξ	ksi
Γ γ	gamma	Ο ο	omicron
Δ δ	delta	Π π	pi
Ε ε	epsilon	Ρ ρ	rho
Ζ ζ	zeta	Σ σς	sigma
Η η	eta	Τ τ	tau
Θ θ	theta	Υ υ	upsilon
Ι ι	iota	Φ φ	phi
Κ κ	kappa	Χ χ	chi
Λ λ	lambda	Ψ ψ	psi
Μ μ	mu	Ω ω	omega

Neutrinos

- Leptons
- 3 flavors
- Only weakly interacting—no charge
- Hard to detect
- Very little masses



Muon

- 200x more massive than electron
- Otherwise very similar to electron
- Decays

Tau

- Very massive (more than proton)
- Same charge as muon and electron